Case study: Campeche Bay, Mexico

PERFFLOW CM and Mudzyme fluid systems help drill and complete wells in unconsolidated sandstone formation

The Ek-Balam project, which is located in an offshore field in the north of Campeche Bay, is an unconsolidated sandstone reservoir.

The operator was concerned about formation damage and production screen plugging during a stand-alone screen completion in the horizontal, openhole well due to previously used oil-based muds (OBM) and drill-in fluids supplied by competitors.

To reduce formation damage, improve filter cake removal, and increase production, Baker Hughes recommended its 9.0-lb/gal (1078.4-kg/m^3) **PERFFLOW™ CM water-based drill-in fluid** and its **Mudzyme™ enzymatic filter cake breaker system**.

All of the data needed to design and optimize the solution was provided by the operator.

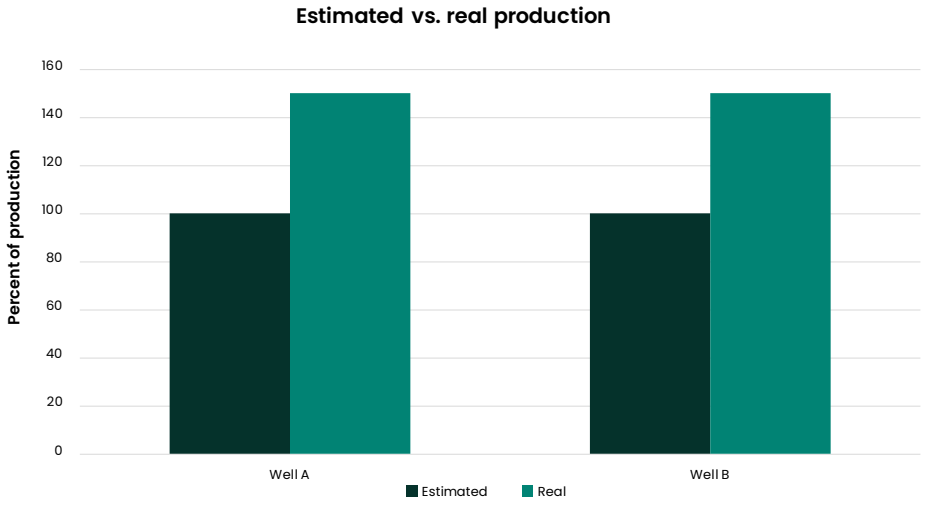
In laboratory tests, the fluid/breaker combination resulted in a 99% return in production permeability. The operator evaluated the combination, deemed it a high performing system, and approved its use for two upcoming openhole horizontal applications.

The first application was a re-entry well. The operator drilled about 500 ft (152.4 m) into the 4 $^1/_8$-in. section with a 40° inclination.

Once total depth (TD) was reached, two displacements of 8.35 lb/gal (1000.5-kg/m^3) potassium chloride (KCl) brine were conducted to ensure the screens were run in a solids-free environment.

The entire PERFFLOW CM drill-in fluid was displaced to a 9.0-lb/gal (1078.4-kg/m^3) KCl brine prior to running the completion screen. Then, an 83-bbl (9.9-m^3) Mudzyme treatment was placed with 1½-in. coiled tubing inside the screens to cover the entire openhole interval.

The Mudzyme breaker was then allowed to soak for a total of 12 hours



Challenges

- First horizontal well with openhole completion in Campeche Bay
- Unconsolidated sandstones with low-fracture gradient and high risk of lost circulation
- Provide a successful displacement of OBM
- Avoid formation damage and maximize productivity Index
- Provide consistent filter cake removal in the horizontal section

Results

- PERFFLOW CM drill-in fluid
- Mudzyme filter cake breaker system
- MICRO-PRIME spacer system
- Produced thin, removable filter cakes
- Provided improved borehole stability and ran screens to bottom
- Avoided fluid losses while drilling the horizontal section
- Designed displacements and reduced rig time and production delays
- Provided efficient and uniform filter cake removal
- Increased production rate by 150% over expected rates
- Reduced skin damage factor to less than expected

to degrade the filter cake in a single treatment.

The second well, the first horizontal openhole stand-alone screen completion application in the offshore region of Campeche Bay, proved more challenging.

The upper section of the well was drilled with an 8.92-lb/gal (1068.9-kg/m3) OBM that had to be removed. The section also had to be cleaned of oily residue and debris and the surfaces water-wetted prior to drilling the reservoir section with a water-based fluid (WBM).

The Baker Hughes **MICRO-PRIME™ high-efficiency wellbore-cleaning spacer system** was used to ensure the well was clean prior to circulating the PERFFLOW CM drill-in fluid into this very challenging well.

While drilling the 6-in. openhole horizontal section, the PERFFLOW CM fluid maintained wellbore stability, improved hole cleaning, and avoided losses into the formation while drilling.

The drill-in fluid's proposed key performance indicators were achieved and the PERFFLOW CM system was then displaced.

The openhole section was filled with viscosified 9.0-lb/gal KCl brine and clean completion brine. The 4½-in. stand-alone screen completion assembly was run in hole without problems and the Mudzyme breaker was placed inside the screens to degrade the filter cake.

A second Mudzyme breaker treatment was considered to ensure a homogeneous filter cake removal after fluid losses occurred.

With the results from these two wells, Baker Hughes demonstrated that the combination of the PERFFLOW CM water-based drill-in fluid and the Mudzyme enzymatic filter cake breaker system designed for unconsolidated sandstone formations can provide excellent reservoir productivity results.

Both wells indicated skin factors of nearly zero, and the production rate increased by 150%.

Project highlights

Well	Well A (re-entry)	Well B (horizontal)
Open Hole	541 ft	2.529 ft
Diameter	4 1/8-in.	6-in.
Angle	40°	92°
Drill-in Fluid	9.0-lb/gal PERFFLOW CM fluid	
Completion Type	Stand-alone screen	
Completion Fluid	9.0-lb/gal KCl brine	
Breaker Fluid	Mudzyme system	
Production System	Electrical submersible pumping system	

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